General Application Name: Finance/Tax Parcel Mapping

Product / Service / Function Name: Equalization

P/S/F Description:

Equalization refers to the process that determines the property tax base for a county or city in order to ensure that property taxes are imposed in a fair and equitable manner. Equalization is accomplished using sales and appraisal studies performed on individual property classes (residential, commercial, etc.) in aggregate (not by individual parcels). Most jurisdictions have a Board or Equalization, or similar body, whose main purpose is to correct the inequities that may occur between local units of government as a result of under or over assessment of a property class. The Board also hears tax assessment challenges from citizens who believe their property has been over assessed. The results of the sales and appraisal studies are used to ascertain the true cash value of each property class. The equalization studies are compared to the corresponding property class totals as calculated by the assessor for each county or city. The Board may find it necessary to apply an "equalization factor" to those classes meeting a certain criteria of under or over assessment value. Because equalization involves studying land parcels and assessment data, a GIS application is well suited to provide the type of analysis needed to make sure all citizens are taxed fairly.

Product / Service / Function

1. Spatial Data

Minimum Data Requirements

General Description	GIS Data Layer
Property Data	Parcels
Natural Features	Streams
	Lakes
Transportation	Right-of-way and/or edge of pavement
	Road centerlines
Socio-Political Data	Municipal boundaries
	Neighborhoods & Subdivisions

Optional Data Requirements

General Description	GIS Data Layer
Planimetrics/Base Mapping	Orthophotography
	Building Footprints
Natural Features	Vegetation
	Flood zones
Transportation	Railroads
	Driveways
	Parking Lots
Utilities Data	Water Lines
	Sewer Lines

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	Gas
	Electric
	Storm water
Socio-Political Data	Census Block/Tract
	School Zone
	Zoning
	Land Use

2. Attribute Data –

Minimum Attribute Requirements

GIS Data Layer	**Attributes**
Parcels	Parcel/Tax ID
	Owner Name
	Owner Address
	Property Address
	Subdivision/Neighborhood
	Lot/Legal Description
	Acreage
	Property/Land Use (residential, commercial)
	Assessment Date
	Assessed Personal Property Value
	Assessed Land Value
	Assessed Improvement Value
	Total Assessed Value
	Sale Date
	Appraisal Date
	Appraised Personal Property Value
	Appraised Land Value
	Appraised Improvement Value
	Total Appraised Value
	Sale Price
	Zoning
	Deed Book/Page
Buildings	Feature ID
	Dimensions
Streets	Address Ranges
	Street Name

Optional Attribute Requirements

GIS Data Layer	Attributes
Parcels	Year Addition
	Year Remodel
	Basement Finish
	Heat Type
	Fireplaces
	Construction Quality
	Condition of House
	Curb
	Sidewalk
	Utilities (connected/not connected)
	Stories
	Exterior Walls
	Roof
	Basement
	Year Built
	Total number of rooms
	Number of bedrooms
	Number of bathrooms
	Dimensions
	Garage

3. Data Acquisition Options (integrated with VBMP digital orthos)

The parcels boundaries and some attribute information are usually maintained on paper tax maps. If it has not been completed already, the tax maps must be digitized to create a parcel boundaries GIS data layer. If required, parcel boundaries can also be entered into the GIS using the surveyed dimensions data found on the legal deed. This is accomplished using Coordinate Geometry (COGO) that allows the user to enter a bearing and distance for each segment of the property boundary, given a known geographic point.

The attribute data containing information about property needed for equalization analysis is usually housed in a database such as a Computer Aided Mass Appraisal (CAMA). The data in this database can easily be linked to the GIS parcel layer using a common field in both datasets, most often the PIN (Parcel Identification Number) or another unique property ID number.

Planimetric data such as utilities, buildings, land use, streets, etc. are typically maintained at the county or city level, and are often distributed free of charge to local municipalities. Street centerline data layers of varying qualities can be obtained from a number of vendors. The market is relatively competitive, and prices will vary with quality of the data. Relevant vendors that provide this kind of spatial data on a regional and national scale include: NAVTECH <www.navtech.com>, GDT <www.geographic.com>, and TeleAtlas <www.teleatlas.com>.

Other spatial data layers can be obtained through the Internet from various government sources. Municipal boundaries and similar layers can be obtained in digital format through the U.S.

Census Bureau <www.census.gov>. Floodplains can be obtained through the FEMA Web site <www.fema.com>.

Regardless of the source of the data, each data layer used to build the property equalization application should be consistent with, or be modified to match, the projection of the Virginia Base Mapping Project (VBMP) orthophotography. This is vital for data consistency across the state and facilitates data sharing across jurisdictional boundaries. The digital orthophotography provides an excellent base data layer on which to display the property boundaries and associated information.

4. Data Conflation Options (integrated with VBMP digital orthos)

Data conflation is a process by which two digital data layers, usually of the same area at different points in time, or two different data layers of the same area, are geographically "corrected" through geometrical and rotational transformations so that the different layers can be overlaid on one another. Also called "rubber-sheeting," this process allows a technician to adjust the coordinates of all features on a data layer to provide a more accurate match between known locations and a few data points within the base data set. A good base layer to use for data conflation is the VBMP orthophotos since many features can be seen or interpreted. The need and processes for conflation varies between sets of data, users, and feature types. Any dataset that is updated independently by different departments can be consolidated through conflation. Within most local governments, individual departments are responsible for maintaining specific datasets within their expertise; therefore, conflation is not often necessary. Often, reprojecting the data into a different coordinate system will take care of the misalignment of different data sets. Most industry-standard GIS software has the ability to perform data conflation.

In the case of property boundaries, it is more efficient to digitize them directly on top of the VBMP orthophotography, if a parcels layer does not already exist. Many property boundary features such as fence lines, driveways, and streams can easily be identified on the orthos. If a parcel data layer already exists, perhaps in CAD format, then it will need to be converted to GIS format and reprojected in order to match the projection of the VBMP orthophotos.

5. GUI / programming options

There are many options for developers of a GIS-based equalization application. Three avenues within this development track are:

- Off-the-shelf GIS desktop application that can be customized to the user's needs
- Existing commercial applications.
- Hiring a consultant to develop a custom system from scratch.

Using a standard GIS software package often requires a significant amount of training and customization. Whereas the initial cost may be lower, the time invested in learning these solutions may generally increase the overall expense of implementation. However, standard GIS software packages deliver more robust data integration, analysis, and cartographic capabilities than do other specialized commercial applications. They have a greater user support infrastructure that allows users to overcome problems quickly. Options for using an existing, industry-standard GIS software application that can be customized for equalization analysis include those listed in the following table:

Standard GIS Software Vendors:

Vendor	Software	Web Address
ESRI	ArcView 3.x	http://www.esri.com
ESRI	ArcGIS 8.x	http://www.esri.com
MapInfo	Professional 7.0	http://www.mapinfo.com
Intergraph	GeoMedia 5.0	http://www.intergraph.com/gis
Autodesk	Map 5.0	http://www.autodesk.com

There are an increasing number of vendors developing and implementing parcel management software, including components for assessment and equalization functionality. These products may often cost more than standard GIS solutions because of the customization that is required to fit the application into the agency's business practices and/or connect to its data source. The advantage is that a tailored application provides just the functionality that is needed, decreasing the overall application overhead common to industry-standard GIS software. Options for using an existing, commercial parcel management include those listed in the following table:

Commercial Software:

Vendor	Product	Web Address
NovaLIS Technologies	Assessment Office	http://www.novalistech.com
RPT, Inc.	GeoPlan – Property Management	http://www.rpt.com/GeoProperty.htm
Hansen Information Technologies	Tax Assessment Module	http://www.hansen.com/doc.asp?ID=67

The final option for developing and implementing a GIS-based equalization application is to contract a consultant. This option makes certain that a product will fulfill a jurisdiction's requirements. A consultant will be able to develop an application that works with the wide range of hardware and software that are currently in use within local governments within Virginia. Also, training and follow-up user support is often provided at a much more substantial level than with other options.

There are a number of functions that a GIS application could perform for equalization analysis. A GIS has the ability to analyze locational information and the relationships between parcels in a given geographic area. For example, it is possible for a homeowner to compare the total value, total living area, value per square foot, and current sales information for their own property and their neighbors. Even more valuable is the possibility to display these parameters as a percentage. For example, the parcels can be displayed as being valued 20% higher or lower than a neighboring property. This type of application would be very powerful and would greatly assist the Board of Equalization in making sure that property taxation is fair.

Another potential time and money saving project might be to set up a specialized GIS application in a public kiosk or computer station that would allow the community to research their property assessment. The main advantage to this type of analysis is that it can reduce the number of tax protests because citizens can see clearly the assessment patterns for their neighborhood on an interactive map.

6. Internet Functionality and options

The Internet has proven itself as a viable solution for local governments to centralize the maintenance and management of services and data. As more local governments are implementing Web-based solutions, they are finding that the Internet requires them to change the nature of an application or its usefulness. Through the flexibility of an Internet solution, software can be easily updated, and users gain greater accessibility to the applications and information they need for their specific tasks through simple, user-friendly interfaces.

Similar to the public kiosk described in Section 5, a similar application can be deployed on the Web to allow an even greater access to this information for the community. It is also important to point out that Virginia law allows the dissemination of property information via the Web as it is public information. GIS software vendors have products that can be customized in-house or by a consultant to provide Web GIS applications on the Internet, over an intranet or via wireless network. The table below shows GIS vendors and their Internet mapping solutions.

GIS Internet Solutions

Vendor	Internet Software	Web Address
ESRI	ArcIMS	http://www.esri.com/software/arcims
MapInfo	MapXtreme, MapX	http://www.mapinfo.com
Intergraph	GeoMedia WebMap	http://www.intergraph.com/gis/gmwm
Autodesk	MapGuide	http://www.autodesk.com

7. Technical Requirements

Minimum Technical Requirements
At its most basic level, a GIS-based equalization application can be used on a single, stand-alone workstation. This workstation would have a hard drive that stores all of the spatial data layers, as well as the GIS software package or application itself. A typical workstation running off-the-shelf software should have the following minimum specifications:

Processor:	Pentium 3; 450 MHz
RAM:	128MB SDRAM at 133MHz
Hard Disk:	20GB (min.)
Monitor 1:	19"
Floppy Drive:	3.5”
CD-ROM:	12x/8x/32x CD drive
Modem:	56K
OS:	Windows 2000/NT/XP
Office:	Windows 2000 Professional
Printer:	8x11 office-grade color printer

Optimum Technical Requirements:
A more complex application may require multiple components, including servers, desktop workstations, or handheld devices. The scale at which the system is implemented, thus the technical needs, is dependent on the number of daily GIS users as well as the number of data collectors. For either a desktop or a Web-based application, the system should rely on a fairly

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robust server computer and high-end workstations. Some examples specifications of the necessary equipment are listed below:

Server

Processor:	Min. 2x Processors, 1.7 GHz, 512K cache
RAM:	Min. 2x 512MB RIMMS
Hard Disk:	Min. 2x 80GB +RAID
Monitor 1:	19"
Floppy Drive:	3.5”
CD-ROM:	12x/8x/32x CD drive
Modem:	56K
Network Card:	10/100 mbps

Workstation

Processor:	Pentium 4, 1.5 GHz
RAM:	512MB SDRAM at 133MHz
HardDisk:	20GB (min.)
Monitor 1:	19”
Monitor 2:	17”
Floppy Drive:	3.5”
CD-ROM:	12x/8x/32x CD-RW drive
Modem:	56K
Network Card:	10/100 mbps
OS:	Windows 2000/NT/XP
Office:	Windows 2000 Professional

Other Components

Printer:	8x11 office-grade color printer and 8x11 production b/w printer
Plotter:	HP DesignJet 1055CM
Tape Backup:	Tape Library Server
UPS:	APC 1400 (or other similar)
Scanner:	11x17
Handheld:	Compaq IPAQ
Network:	T1

8. Administrative/Management Requirements

At the beginning of the project, the assigned project manager from the particular municipality should consider completing some, if not all of the following tasks that relate to the administrative requirements of an equalization application:

- Determine, with or without the assistance of a consultant hired to develop the system, the preliminary vision and goals of the project.
- Coordinate an initial meeting with the decision-makers (i.e. the Board of Supervisors, City Council, planning department, property assessor, Board of Equalization, etc.) where the vision and goals of the project are expressed and the background of GIS technology is described, if needed.
- Coordinate with other municipal agencies for data sharing provisions.
- Determine a mechanism of communication to keep the decision-makers aware of the progress of the project.

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- Develop a basic understanding of the available precedents in the region/state and research the available technologies that can be applied to the project.

Upon project completion, a basic GIS-based equalization application will require very little administrative support. Administrative tasks may include loading or upgrading new versions of the software or patches, providing for constant data flow from the source database, and maintaining yearly support contracts on the hardware and software. However, once the system becomes distributed as an enterprise solution to many users throughout a department or deployed on the Internet, there are various other management requirements that need to be fulfilled on a weekly or monthly basis.

At the point where the system grows beyond single desktop users, a devoted administrator or system manager needs to be established. This is essential for the following reasons:

- The system will now be interfacing with other technology systems already in place. Therefore, someone needs to maintain contact with the technology personnel that maintain these systems.
- The manager needs to put into place training schedules to maintain user knowledge of the system.
- Funding will undoubtedly be required to either maintain the system long-term, or continue to expand the system, which requires funding research and applications for grants.

9. Cost – Cost/Benefit

Hardware	**Typical Unit Cost**
Minimum Workstation	$2,000
Optimum Workstation	$3,200
Laptop	$2,400
Web/FTP Server	$8,500
Database Server	$12,000
Data Warehouse Server	$18,000
Backup Server	$5,800
Printer (8x11 color)	$700
Printer (8x11 b/w production)	$2,000
Plotter	$12,000
Tape Library	$5,000
UPS (Universal Power Supply)	$700
Scanner	$1,500
Handheld	$300-$700

Software (all prices included license)	**Typical Unit Cost**
Standard GIS desktop software	$700-$10,000
Customized desktop vendor solution	$5,000-$15,000
Web-based vendor application	$15,000-$25,000
Customized web-based vendor solution	$20,000-$60,000

Miscellaneous	**Typical Unit Cost**
Training – focused vendor training (per	$700-$1,000

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person)	
Training – general GIS	$700-$1,200
Licensing – desktop	$100-$500
Licensing – webapp (1st CPU)	$7,500-$12,000
Maintenance (per year)	$8,000-$15,000

10. Standards / Guidelines Summary
    - Consider creating, customizing, or purchasing an application that integrates equalization functionality with other parcel management issues such as assessments, parcel inventory, or parcel ownership history. This is most likely a more cost-effective solution.
    - A GIS-based equalization application should be built so that non-technical personnel can be trained to use the system.
    - A Web GIS equalization application should be even more simplified for the average citizen to use to research their neighborhood assessment information before appealing to the Board of Equalization.
    - Acquire input from all departments who will be involved in funding and/or utilizing the application before proceeding with the application design.
    - Create a standardized parcel identification number (PIN) to be used in the application to relate external databases to the GIS parcel data.
    - Determine what information (attributes) about the parcels will be obtained from tax/parcel maps and deeds before digitizing the tax/parcel maps.
    - Develop a detailed Quality Assurance/Quality Control (QA/QC) procedure for reviewing the accuracy of the GIS data and its attributes.
    - Maintain data in the VBMP standard coordinate system (Virginia State Plane, NAD 83, Survey Feet).
    - Create metadata (standard information about GIS data) for each data layer. Metadata tracks the date, origin, coordinate system, and other such information for data layers.

11. Startup Procedures/Steps

    There should be a minimum of eight steps involved with developing a GIS-based equalization application, after funding is in place to support the project. The steps can be performed in-house or by a consulting team.

    The first task is to complete a detailed Needs Assessment. This process gathers information regarding existing operational procedures, hardware and software, GIS data, and personnel needs. It should include interviews of key individuals throughout the local government agency and other related government departments to obtain a comprehensive view of the agency's operations, and where GIS might improve them. Basic GIS concepts should be discussed and illustrated to those interviewees that have little prior understanding of GIS. A comprehensive Needs Assessment should then be compiled from the results of the interviews. This document explains the various requirements for a GIS-based equalization application in the following areas: personnel needs, spatial data development needs, applicable spatial analysis techniques, basic system requirements, including preliminary, general hardware and software recommendations, and training needs.

    The second task is to develop a functional requirements document for the proposed system. This document should describe, as completely as possible, all of the technology and functionality that

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is to be included in the property equalization application. This document is used by the local government agency, or its consultant, as the blueprint for the GIS application or system.

- Hardware specifications
- Software purchases
- Detailed descriptions of work-flow, and examples of the graphic user interfaces
- Describe each tool that is part of that graphic user interface, and its functionality
- Describe how data would flow between the different databases and data warehouses, if applicable
- Describe the redundant security measures that will be put in place to make certain of data integrity and confidentiality, when applicable
- Analytical techniques that the application/system provides the user for equalization analysis
- Describe each of the potential products (reports, maps, charts, summary tables) that the user will be able to generate within the system

The third task should be to compile or develop spatial data that can be used by the evolving application. Data can be gathered from a number of online sources, as well as county/city departments. The data layers gathered and maintained should match at least the minimum list provided in Section 1 of this document and can be acquired through the methods described in Section 3 of this document.

On completion and acceptance of the functional requirements document and the development of the spatial and attribute data, the system development and test phase can begin. During this time, the application will be customized as it was outlined in the functional requirements phase. The local government agency should require periodic reviews of the application at particular milestones, such as 50% and 75% completion. This will make certain that problems with the application will be recognized early in the development process, and that the local government agency remains a part of the development process throughout the project timeline.

When the application is nearing 100% completion, it should be installed and tested in the environment in which it will ultimately be used. This allows the users to test the system alongside the application developers, and determine any system integration problems that might arise. It also gives the developers the opportunity to test the application's functionality in a real-world situation. This testing process should be as comprehensive as possible. Each process detailed within the functional requirements should be tested and evaluated at this point.

User training commences once the application reaches 100% completion and is fully documented. Different levels of tutorials and system documentation should be developed depending on the hierarchy of users. Time should be spent at this stage of the project with each potential user of the system to make certain that the proper education occurs. Training should be done through lessons that use real-life examples of system application. This strategy greatly enhances users' ability to apply the functionality to their jobs.

The next phase of the project should include a document that describes a future plan for wider system development. This document accomplishes two goals. The future plan gives the local government agency ideas on how the system might grow to assist other facets of its business practices. Secondly, it provides the agency with a ready-made grant proposal for applying for potential funding sources.

The final phase of a successful implementation of a GIS-based equalization application is ongoing technical support. The local government agency should always include this contingency within its cost estimates of a project for a minimum of three months after a system has been put into place. No matter how effective an application appears, problems and system changes inevitably impact the functionality of an application.

12. Estimated time line and/or implementation (stand alone) schedule

Phase	Approximate Duration
RFP/Contract process (construction, posting, proposal acceptance, review, award of contract)	4 months - 1 year
Needs Assessment	2 months
Functional Requirements	1-2 months
Data Development	6-12 months
System Development and Testing	2-4 months
Installation and Testing	1 month
User Training	½ month
Plan for Future Development	½ month
Ongoing Support	3 months

13. Best Practice Examples in Virginia

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Department of Tax Administration
12000 Government Center Parkway
Fairfax, VA 22035
703-324-4891
http://www.co.fairfax.va.us/dta/re/